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THE CENTRAL AFRICAN JOURNAL OF MEDICINE

ORIGINAL ARTICLES

Reduced semen quality and risk behaviour amongst men consulting a referral STD clinic

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M BASSETT², E MAROWA³, L MBENGERANWA⁴

SUMMARY

Sexually transmitted diseases (STDs) and infertility are public health challenges that continue to represent a high demand and costly adult medical care conditions in most developing countries. Few studies address strategies for prevention of infertility secondary to STDs through behavioural change and early and prompt STD treatment. A prospective cohort design was used to study the effects of urogenital infection on semen quality in consenting consecutive subjects that presented with chronic or recurrent sexually transmitted diseases. Health seeking behavioural correlates and socio-economic variables were compared between index subjects at a genito-urinary referral clinic and those that presented with non-STD conditions at a referral polyclinic.

The majority of both STD and control subjects were married men. The largest proportion of married STD subjects (67,0 pc) reported that they were migrant workers and did not live with their wives, as compared with non-STD subjects (60 pc), who lived with their wives ($p < 0,01$). Furthermore, control subjects were more likely than STD subjects to commute to their communal homes within a 60 day interval. Up to 78 pc of STD subjects reported that they had paid for sexual intercourse with commercial sex workers, as compared with 39 pc of control subjects (Odds Ratio [OR] = 3,7, 95 pc CI = 1,2 – 6,9). Amongst married STD subjects, 10,2 pc were infertile by WHO definition, although none had yet consulted an infertility clinic.

Poor semen quality was observed with bacteriospermia. *Chlamydia trachomatis* positive ejaculates exhibited increased asthenozoospermia as compared with negative ejaculates (OR = 3,0, 95 pc CI = 1,3 – 6,5). Bacteriospermia was often associated with circular, sluggish and non-progressive motility as well as bent midpiece of sperm.

Thus, chronic sequelae, such as infertility, may occur long after STD infections, among couples whose behaviour no longer poses a high risk of infection. Health education programmes should alert communities on the risks of STDs and subsequent infertility. Equally important is the need to address the socio-economic and demographic conditions under which the diseases are propagated.

INTRODUCTION

Both sexually transmitted infections and infertility place a high demand on medical care in most parts of the world. In developing countries especially in sub-Saharan Africa, demographic and medical literature in the past decade demonstrate attention to sexually transmitted diseases (STDs). In 1983, Frank¹ concluded that infertility accounted for 60 pc of the among country variation in total fertility rates in sub-Saharan Africa. Caldwell and Caldwell² attributed most of the differen-

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tial fecundity to STDs, especially gonorrhoea, although Bongaarts³ argued that there were four variables accounting for 97 pc of the variance, being married proportion, contraception, abortion and past postpartum infecundity. In a comprehensive review, Sherris and Fox discussed the public health challenge posed by STDs.⁴

Many of the biomedical and therapeutic studies that have advanced our knowledge of the association of STDs and infertility in men have been case histories. Thus, for ethical reasons they formed the best basis for inferring causality as it would not be permissible to randomize patients into infected and non-infected groups and then follow them forward in time to determine their reproductive capacity. There is an interval of 12 or more months between the time an infertile couple tries to conceive and the time they seek medical advice. Thus, recall bias presents an important methodological problem. However, it is possible to quantify the absolute risk and eliminate recall bias in a dynamic cohort and case referent approach that proceeds conceptually from exposure to development of sequelae or measure outcome variables following known presence of adverse exposure.

In the female, tubal infertility can be the result of pelvic inflammatory disease provoked by a sexually transmitted pathogenic agent, mainly *Neisseria gonorrhoeae* and *Chlamydia trachomatis*. The prevention of tubal disease may be achieved by early treatment of the infection. In men, the major complication of gonococcal or chlamydial infection is epididymitis and, if untreated, obstructive azoospermia is possible. Often, couples consult for medical advice on infertility long after such complications. Apart from obstruction, infertility could be a result of deficient semen quality thought to be induced by infection. Also, possible levels of prevention of infertility secondary to such infections are complicated by absence of data on sexual and health seeking behaviour patterns prevailing before consulting for infertility investigation. Such infections could thus present as acute and systemic or, as silent (subclinical) bacteriospermia.

Since male fertility is through adequate sperm function, the present study sought to determine parameters of semen quality affected by urogenital infections as well as background behavioural patterns associated with such infections.

MATERIALS AND METHODS

Design and subject selection: A prospective cohort study of consenting consecutive male patients (635)

referred for investigation and treatment of recurrent or chronic sexually transmitted diseases at the Genito-Urinary Centre (GUC), City of Harare, was carried out. Patients were referred from primary health care clinics, general medical practitioners and district hospitals because of recurrent or chronic urogenital infections or complications of such infections. Informed consent was obtained from all study patients and recruitment was confined to subjects that were able to produce masturbated semen samples at the clinic. Questionnaire data on socio-demographics and behavioural patterns was obtained from all subjects and a subsample of non-STD referent patients (132) from Harare Central Hospital. Physical examinations including testicular size using the Prader orchidometer and consistency were performed.

Specimens collection: Subjects were provided with two wide mouth, sterile glass specimen containers labelled with their name, study number and date. They were asked to provide first a mid-stream urine, followed by a masturbated semen specimen into the second container. The date of the last ejaculation for each subject was noted. Disposable gloves were used to handle specimens and special plastic containers were employed for waste disposal.

Specimens processing: Semen was analysed following liquefaction using WHO standard techniques.⁵ Liquefaction time and appearance were recorded followed by volume, viscosity, pH, motility, sperm density, morphology and viability. A Makler counting chamber (SEFI Medical Instruments, Haifa, Israel) of 10 micron depth was used to study sperm under a phase-contrast Olympus BH-S microscope (Olympus Optical Co., Ltd, Tokyo, Japan). Concentration of cellular elements and White Blood Cells (WBC) was estimated per visual field in the wet preparation or, if $< 10^6/\text{ml}$, a peroxidase stain was used to confirm abnormal WBC count.⁵

Semen swabs were collected and inoculated directly onto modified Thayer-Martin (TM) Medium⁶, containing trimethoprim, nystatin and colistin before incubating at 37°C in a 10 pc CO₂ atmosphere for identification of *Neisseria gonorrhoeae*. A second semen swab was inoculated onto duplicate blood agar plates, a MacConkey and chocolate agar plates for aerobic and anaerobic culture of other microorganisms. A third semen swab was collected for qualitative detection of *Chlamydia trachomatis* using the Chlamydiazyme enzyme linked immunoassay (ELISA) kit (Abott Laboratories Chicago, ILL).

For the detection of *Treponema pallidum* antibody both the Rapid Plasma Reagent (RPR) screening test, and the *Treponema pallidum* Haemagglutination test (TPHA), were used.

Statistical analysis: The Quest and Statistical Analysis Systems (SAS) computer software programmes were used to stratify and analyze results. Logistic regression models were used to examine the effects of specific STDs. The significance of association between group means were calculated from Z-scores or chi-square (X^2) tests and relative risk ratios (RR) according to Meitinen.⁷

RESULTS

Sociodemographic features: The mean age for STD patients was $27,5 \pm 6,5$ years (\pm SD) and that for the control group was $34,1 \pm 10,3$ years (mean \pm SD). Frequency distribution of STD and control subjects according to age is shown in Table I.

Table I: Distribution of STD and control subjects according to age.

Age (years)	STD subjects		Control subjects	
	Frequency	pc	Frequency	pc
15-19	32	5,0	6	4,5
20-24	212	33,4	19	14,4
25-29	182	28,7	26	19,7
30-34	115	18,1	25	18,9
35-39	55	8,7	20	15,2
40-44	29	4,6	15	11,4
45+	10	1,5	21	15,9
Total	635	100,0	132	100,0

The largest proportion of both study and control subjects attended school with only 1,3 pc of STD patients and 4,6 pc of control subjects not having attended school. The mean number of years in school in both groups was comparable, being $8,6 \pm 2,6$ years (mean \pm SD), with an upper quartile of 11,0 years and lower quartile of 7,0 years in the STD patient group and in the control group the age was $7,5 \pm 2,3$ years (mean \pm SD) with an upper quartile of 9,0 years and a lower quartile of 7,0 years in the control group. Sixty four pc of STD patients and 55 pc of controls had secondary or higher education.

The distribution of STD patients and control subjects by type of residence was comparable, with the majority in both groups residing in the high density residential area.

The employment status of STD and control subjects was compared and distributed as depicted in Table II.

In both STD and control subjects the largest proportion of men reported that they were married. The marital status of study subjects is also shown in Table II.

Table II: Distribution of STD and control subjects by residential type and marital status.

Area Type	STD subjects		Control subjects	
	Frequency	pc	Frequency	pc
High density	494	77,8	106	80,3
Low density	73	11,5	10	7,6
Communal	18	2,8	7	5,3
City centre	13	2,0	1	0,8
High density (Domestic)	3	0,5	2	1,5
High density (Domestic)	34	5,4	6	4,5
Total	635	100,0	132	100,0
Marital status				
Married	331	52,1	92	69,7
Single	267	43,5	25	18,9
Divorced	21	3,3	4	3,0
Widowed	3	0,5	3	2,3
Cohabiting	4	0,6	8	6,0
Total	635	100,0	132	100,0

Of the 331 married STD subjects, the largest proportion (67,0 pc) reported that they did not live with their wives as the wives lived in the communal areas. On the other hand, 60,0 pc of control subjects lived with their wives in the urban area. Furthermore, control subjects were more likely than STD subjects to commute to their communal homes within a 60 day interval. Up to 77,8 pc of STD patients reported that they had paid for sexual intercourse with commercial sex workers as compared with 39 pc of control subjects (OR = 3,7; 95 pc CI = 1,2 - 6,9; $p < 0,01$).

Amongst married STD patients, 10,2 pc reported that they were involuntarily childless after a year or more of marriage whereas none of the control married subjects were infertile ($p < 0,05$; 95 pc OR = 2,2) by WHO definition.

The mean duration of time between the onset of the medical condition and seeking help from the referral clinic was 4,9 weeks amongst STD subjects and 2,0 weeks amongst controls although in each case, primary consultations by the majority of patients were at pri-

mary clinics (55,1 pc and 68,2 pc amongst STD and control subjects respectively). Further, the majority of STD patients (70,4 pc) reported having contracted single or multiple genito-urinary infections at least three times during the preceding three years.

Physical characteristics: No varicoceles were detected on clinical examination of control subjects except for two (0,3 pc) STD patients. The combined mean testicular volume in the control subjects was $17,5 \pm 3,4 \text{ cm}^3$ (mean \pm SD) while that in the STD subjects was $15,4 \pm 4,4 \text{ cm}^3$, indicating a slight but not significant reduction ($p > 0,05$) in testicular size amongst the STD patients. The median testicular volumes were $15,0 \text{ cm}^3$ and $20,0 \text{ cm}^3$ respectively. Reduced testicular volume ($\leq 10 \text{ cm}^3$) was present in 5,5 pc of STD patients and in none of the control subjects.

One hundred and forty (22 pc) of STD subjects presented with orchitis, being unilateral in 12 pc and bilateral in 10 pc. Thickened epididymis was also present in 14 pc of STD subjects.

Semen quality: The semen volume in STD patients was $2,46 \pm 1,6 \text{ mls}$ and that in the control group was $2,95 \pm 0,88 \text{ mls}$.

The mean pH was $7,7 \pm 0,7$ (\pm SD) amongst the STD subjects, compared with pH $7,5 \pm 0,65$ amongst controls. The semen liquefaction time was up to 20 minutes in 72,1 pc of STD subjects, which was comparable with that of the majority (91 pc) of controls. However, 14,5 pc of STD patients exhibited liquefaction problems after 30 or more minutes of ejaculation.

The mean sperm viability was $67,2 \pm 24,6$ (\pm SD) in the STD group which was lower when compared with that in the control group of $88,6 \pm 10,1$.

Sperm from STD subjects exhibited poor motility ($49,9 \pm 20 \text{ pc}$) as compared with non STD controls ($70,5 \pm 0,88 \text{ pc}$, $p < 0,01$). The largest proportion of STD subjects (60,1 pc) had a non-progressive motility and 13,1 pc had a sluggish or circular motility pattern.

In terms of appearance, the largest proportion of STD subjects' semen samples displayed mucoid (27,1 pc) followed by watery (25,5 pc), streaked and cloudy (4 pc) appearance. Haemospermia was present in 16 pc of the STD patients.

Abnormal sperm morphology was present in 45 pc of STD patients, as compared with 20 pc of study controls. The most common sperm cell abnormalities detected were bent midpiece (26,4 pc), tapered head (22,8 pc), amorphous head (15,7 pc), immature forms (19,3 pc) and combined sperm defects (15,8 pc).

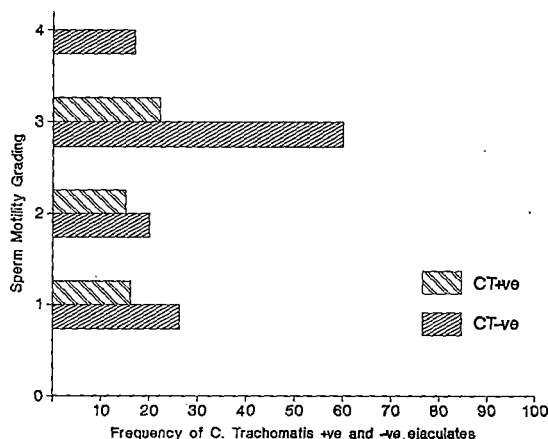
The sperm concentration amongst STD patients was $42,4 \pm 30,3 \times 10^6$ per ml and that amongst controls was $55,6 \pm 20,21 \times 10^6$, which did not exhibit significant differences when azoospermic samples were excluded. However, 28 STD subjects (4,0 pc) were azoospermic, with the largest proportion being in the epididymo-orchitis group. There were no azoospermic control subjects. Oligozoospermia ($< 20 \times 10^6/\text{ml}$) was present in 27 pc of STD subjects and no oligospermia was detected in control subjects.

A high white blood cell count was found in the semen of 34 pc of the STD patients, as compared with 12 pc in control subjects.

Infections: In a sub sample of 171 STD subjects tested for *Chlamydia trachomatis*, 36,6 pc tested positive and up to 62,5 pc of semen samples with chlamydial infection had sperm motility that was less than 60 pc compared to 42 pc of *Chlamydia trachomatis* negative specimens ($df = 4$, $p < 0,5$). Sluggish and non-progressive motility (grade ≤ 2) was present in 65 pc of Chlamydia positive samples, compared with 33 pc in Chlamydia negative specimens (OR 3,0, 95 pc CI = 1,3 – 6,5). Figure I shows the relationship of Chlamydia infection to sperm motility.

Sperm viability did not show a significant difference between the Chlamydia positive and negative specimens ($p = 0,2$), although mean pc viable was lower in the Chlamydia positive specimens. The presence of teratozoospermia was also comparable to both groups, although 52 pc of Chlamydia positive specimens exhibited sperm cells with a bent midpiece that resulted in asthenozoospermia.

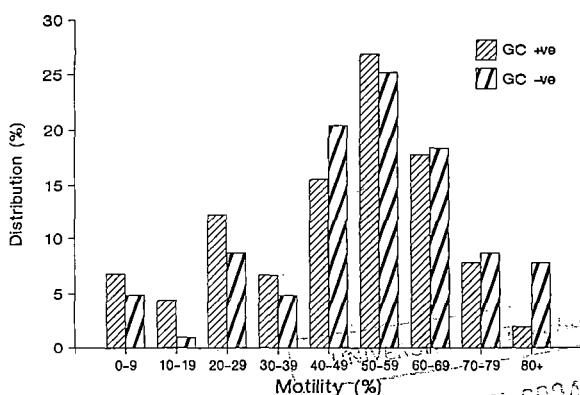
Figure I: Relationship of *C. trachomatis* infection to sperm motility grading.



Sperm cell concentration did show a significant difference in the two groups, although there were no motile sperm concentrations above 80×10^6 per ml in the *Chlamydia trachomatis* positive ejaculates, compared to 13 pc of Chlamydia negative specimens with such concentrations.

The relative and attributable infertility risks associated with Chlamydia infection were 2,2 and 0,25; 95 pc CI=0,20–0,38 respectively. When semen quality was evaluated in relation to *Neisseria gonorrhoeae* (GC) infection in 80 GC positive specimens, there was no rapid progressive motility (grade 4) in positive specimens compared with 10 pc of negative specimens exhibiting progressive motility quality. The distribution of sperm motility (pc motile) in GC positive and GC negative specimens is shown in Figure II.

Figure II: Relationship of GC infection to sperm motility.



Sperm viability, concentration, morphology and pH did not show significant difference with GC infection.

Mucoid semen appearance was associated with B-haemolytic streptococci infection. Other common isolates from asthenospermic samples were Klebsiella, non-haemolytic streptococcus and *E. coli*.

DISCUSSION

The present study identified sexual behaviour, poor health seeking patterns and rural/urban migration trends that impacted adversely on fertility through infections. The majority (67 pc) of patients referred for chronic or recurrent STD infections were under 30 years of age, with the modal group aged 20 to 24 years as compared

with the control group where only 38,6 pc were below the age of 30 years of age. Thus, health education programmes on STD prevention and strategies for behavioural change need to target the men at a much earlier age. Such health education should include recognition of infection symptoms and promptly seeking medical advice.

The likelihood of contracting sexually transmitted diseases did not appear to be influenced by the number of years in school, as only 1,3 pc of STD patients had not attended school, as compared with 4,6 pc of study controls. In fact, a higher percentage of STD patients had attended secondary school compared with controls. This could be a result of higher mobility with the attainment of higher education and consequent changes in sexual behaviour in the studied population. Although the majority of non-STD study controls lived with their wives, they were more likely to commute to their communal homes than did STD patients.

Thus, the STD population tended not to live with their wives and also visited their wives less frequently than did controls and this constituted a significant risk for STD contraction. Measures to regularize the pattern and provide allowances at work places to accommodate wives should therefore reduce this problem. Commercial sex was also much more evident in the absence of regular rural visits. The spread of infection as a result of people becoming more mobile with industrialization was also observed by Oriel.⁸

Whereas there was no noteworthy aversion to medication, STD subjects were invariably late in seeking medical care or avidly practiced self medication. This underscores the universal need to communicate to the public the importance of seeking prompt medical care. There was also a high rate of repeated infections amongst the STD patients associated with inadequate treatment which could predispose to infertility.

While the spread of STD agents from the lower to the upper genital tract may be prevented by early treatment, a large proportion of STD patients presented with epididymitis or orchitis. Thus, whereas poor sperm quality in terms of motility and viability was often seen with infection, the epididymo-orchitis patients also had oligozoospermia and azoospermia. In a study on 59 subfertile males in Sudan, Omer,⁹ found a history of past inflammatory conditions that were associated with infertility. In another study of 102 infertile men by Jequier,¹⁰ the response to vasaepididymostomy cor-

rective surgery was poor, despite obstruction making up 60 pc of the azoospermic patients.

Sperm progressive motility was poor with a large number of STD patients' samples exhibiting sluggish and circular sperm movement. Previous studies amongst infertile men¹¹ showed a decline in sperm concentration which correlated with poor motility and morphology. However, in the present study there was poor motility and morphology despite a normal sperm density in some instances.

Chlamydia trachomatis positive semen samples exhibited sluggish and non-progressive motility. In a study of 59 men with *Chlamydia trachomatis* by Grant *et al*¹², 44 pc presented with epididymitis, 14 pc with urethritis and 15 pc with prostatitis. In a recent study by Bjereke and Purvis,¹³ almost one quarter of 100 asymptomatic men under fertility investigation had significant titres of IgA antibodies specific for *Chlamydia trachomatis* in seminal plasma, although no clear association was evident between the presence of these antibodies and sperm quality. The authors suggested that chronic asymptomatic infections with *Chlamydia trachomatis* could be responsible for a large number of cases of infertility suggested that all men and women under infertility investigation should be routinely screened with chlamydial serology regardless of previous history and clinical findings. In another recent study by Erbengi,¹⁴ electron microscopy was used to detect the presence of *Chlamydia trachomatis* elementary and reticulate body forms in sperm. The organism was seen not only to adhere to sperm but also penetrated the tail structure.

In another study by Morea *et al*¹⁵ on male infertility caused by subclinical infection of the genital system, Norfloxacin was seen to be highly effective in curing the infection and improving sperm motility. In a recent review, Purvis and Christiansen¹⁶ recommended the use of rectal ultrasound for detecting non-asymptomatic deep pelvic infections in the male. Rectal ultrasound indicated that a large number of men with poor sperm quality had a non-asymptomatic, chronic prostatovesiculitis. They also observed that *Chlamydia trachomatis* could be a major cause of chronic non-bacterial prostatitis with the male accessory glands functioning as reservoirs for the organism, increasing the probability of infection in the female.

The present study gives credence to the investigation of micro-organisms in men presenting with infertility, secondary to poor sperm quality. There is a need to

address the social and behavioural factors associated with STDs and to mount a sustained health education campaign.

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